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MARKET SURVEY OF COMPUTER ASSISTANCE REQUIRED BY FIRMS INVOLDED WITH INJECTION MOULDED PLASTIC PARTS AND MOULDS

By: Ontario Research Foundation
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SECTION I

EXECUTIVE SUMMARY

An exhaustive survey of firms involved with injection moulded plastic parts was completed. These companies either supplied the resins, moulded parts, manufactured moulds, designed parts, and/or designed moulds. Five hundred questionnaires were mailed to a selected group, of which 130 replied. Two hundred were also phoned. In addition, twenty-three personal interviews were conducted with individuals who were particularly knowledgable in the field of CAD/CAM/CAE as applied to plastics.

An overwhelming majority of firms (94% of those with an opinion on the subject), believe that the capability to use Computer Aided Design for moulds will become essential for Canadian firms to be internationally competitive. Also, the majority of companies (86%) would consider using a Centre offering assistance in CAD/CAM/CAE if established in their area.

The majority of companies have not used moulding simulation software. Reasons include:

- Cost
- Accessibility of Service
- Inability to run on their own hardware
- Inability to transfer geometry to systems that have the software
- Lack of rheological data on plastics involved
- Ability to do a good enough job guided by past experience.

Those familiar with CADMOULD are most interested in being able to use it. Ideally, from their point of view, CADMOULD should work on other than DEC hardware and should integrate flow, cooling, and finite element analysis. They would, of course, like it to be lower in cost than current software offerings and interface with CAD and CAM software. Cost is the major restriction on the use, in Canada, of moulding simulation software. Current suppliers have priced their product in U.S. dollars for the largest U.S., German, and Japanese Corporations.

The most advanced systems are estimated to cost $500,000 U.S. plus facilities for a minimum installation using their software. This is prohibitive for most Canadian firms.

In conclusion, there appears to be a genuine interest and need for the follcwing:

1. New software such as CADMOULD.

2. A service centre in Ontario at least, with consideration of one in Quebec and if the cost could be reduced substantially by other applications on the hardware, possibly one in British Columbia.

3. Moulding simulation software for blow moulding.

4. A facility in Canada for establishing rheological and other physical properties of plastics on a routine basis.

SECTION II

GENERAL

CAD/CAM/CAE offer many benefits:

- Reduced commissioning time.	20 to 40%
- Reduced mould cost	5 to 30%
- Improved part quality, fit and warpage	
- Reduced part cost:	
- Reduced resin consumption	0 to 7%
- Reduced part cycle time	0 to 30%
- Reduced scrap	10 to 50%
- Reduced structural failures and warranty costs.	
- Reduced cost for numerical control tape production	20 to 80%

Moulders will find it helps in chosing the right machine based on clamp tonnage and injection pressure requirements, predict cycle times, select optimum settings for a given mould and material, predict effect of changing material, and diagnose problems with existing parts and moulds.

Part designers will be helped in optimizing part weight, part appearance, flatness, weld lines, stresses, material and costs.

Mould designers are helped in optimizing runner and gate designs, reducing regrind, and lowering cycle times.

Mould makers can reduce costs, machining time, re-work, and delivery time.

At the present time, CAD/CAM/CAE actually increases design costs. This is being solved by staff getting more experience and better interfaces being developed between CAD, CAM and CAE software.

DRF

In spite of the advantages, only one Canadian firm in four is planning to use Computer Aided Drafting in design and only one in seven is planning to use Moulding Simulation software on their own computer. The main reasons are cost and lack of knowledge in the area. The lower cost CAD systems that can fit on a micro computer, produce very little savings in plastic part and mould design when compared to doing the work in a conventional manner. If the geometry could be transferred directly from a micro-based CAD system to CADMOULD or similar software, to the production of tapes for Numerically Controlled equipment, substantial savings could be made. Such a system could be sold at a price which could be justified by smaller Canadian firms, but a lot of software development would be required. The alternative for these companies is the use of a service centre if one is available.

SECTION III

HIGHLIGHTS OF THE MAIL SURVEY RESULTS

1. The Respondents

- 500 mail out questionnaires were proportionately distributed by Province.
- 130 or 26% of the surveyed population responded.
- 71% of responses were from Ontario; 18% from Quebec; 3% from British Columbia.
- 81% of the firms responding had fewer than 200 employees.

2. Areas of Activities

- 68% of respondents make injection moulded parts.
- 45% manufacture moulds and dies for plastics
- 44% design moulds for plastics
- 38% design plastic parts

3. Need for Computer Aided Design for Moulds

- 82% believe it is essential for international competitiveness
- 5% believe it is not essential
- 13% no opinion

4. Computer Use or Planned Use

- 78% Business applications
- 24% Computer Aided Drafting and Design
- 22% Computer Aided or Numerical Control Machining
- 14% Plastic moulding simulation.

5. Number of Employees Versus Use of Computer

The following chart indicates the correlation between size of firm and the use it makes of computers. As is to be expected, most firms use computers for business applications.

The only significant difference which appears to emerge between larger and smaller firms, is that of Computer Aided/Numerical Controlled Machining. Smaller firms cite a higher incidence of usage (29%) than larger firms (8%). It is possible that the small sample size of larger firms, or the fact that mould makers are more often smaller firms may account for this discrepancy.

Computer Use	Total		200 or Less		Over 200	
	N	%	N	%	N	%
TOTAL	114	100	90	79	24	21
Business	101	89	79	88	22	92
Computer Aided Drafting and Design	31	27	24	27	7	29
Computer Aided/Numeric Control Machining	28	25	26	29	2	8
Plastic Moulding Simulation	18	16	14	16	4	17
Other Applications	12	11	7	8	4	17

6. Use of Moulding Simulation Software

- 12% have used MOLDFLOW software
- 6% have used MOLDCOOL software
- 3% have used one of:
  - CADMOULD
  - OPTIMOLD
  - TMC
  - MOLDFILL
  - POLYCOOL

Of those who have used the above software, most indicate a good to average level of satisfaction. Some 75% have not made use of any of the above software packages.

7. Number of Employees versus Use of Moulding Simulation Software

MOLDFLOW is by far the most popular software being used by smaller firms. 14/105 or 13% of firms with 200 or fewer employees have made use of MOLDFLOW. 8/105 or 8% have used MOLDCOOL.

Because of the small number of responses, considerable care must be taken in drawing conclusions from this data.

SOFTWARE	TOTAL		200 or Less		Over 200	
	N	%	N	%	N	%
TOTAL	32	100	23	72	9	28
CADMOLD	6	19	3	13	3	33
MOLDFLOW	16	50	14	61	2	22
OPTIMOLD	3	9	2	9	1	11
MOLDCOOL	9	28	8	35	1	11
TOTAL MOULDING CONCEPT	4	13	3	13	1	11
MOLDFILL	4	13	3	13	1	11
POLYCOOL	4	13	3	13	1	11
OTHER	1	13	1	4	0	0

8. Use of Centre

The Centre would be used for the following applications:

- 52% consulting advice
- 50% assistance in plastic moulding simulation
- 46% assistance in part design - drawings
- 41% assistance in mould design - drawings
- 36% training assistance
- 86% would use for at least one function.

With Ontario accounting for 71% of the respondents, the above trend holds true for that Province.

9. Province Versus Use of Centre

The following is a numeric and percentage breakdown by Province expressed in terms of the number of respondents in that Province who would use a centre in their area for the purpose indicated.

APPLICATION	TOTAL		ONTARIO		QUEBEC		B. C.		OTHER	
	N	%	N	%	N	%	N	%	N	%
TOTAL	112	100	78	66	21	18	4	3	8	7
Consulting Advice	68	61	50	64	12	57	2	50	3	38
Training	47	42	35	45	8	38	2	5	2	25
Material Selection	22	20	16	21	2	10	1	15	3	38
Cost Estimation	29	26	19	24	7	33	1	25	2	25
Plastic Moulding	65	58	42	54	13	62	4	100	5	63
Part Design-Drawings	60	54	39	50	10	48	3	75	7	88
Mould Design-Drawings	52	46	36	46	9	43	2	50	5	63
Mould Machining	24	21	17	22	2	10	4	100	1	13
Tape Preparation on Own NC Machines	24	21	17	22	6	29	1	25	0	0
DB or CP-(Walk-in)	10	9	8	10	1	5	0	0	1	13
DB or CP-(Own terminal)	20	18	15	19	2	10	1	25	2	

The foregoing percentages represent only those respondents who indicated interest in using the centre. Of the 130 questionnaires, 112 indicated interest in using the centre for at least one application. Of the 112, 78 were from Ontario, 21 from Quebec, 4 from British Columbia, and the rest from other Provinces.

Caution is advised in placing too much emphasis on the responses from Quebec and British Columbia due to the small sample size.

In Ontario it is clear that a centre which provided the following services would be most in demand:

- 50/78 or 64% of respondents from Ontario who would use the centre, would require consulting advice.
- 42/78 or 54% would look to the centre for assistance in plastic moulding simulation.
- 39/78 or 50% for assistance in design of parts through drawing.
- 36/78 or 46% would seek assistance in mould design - drawings.
- 35/78 or 45% of respondents would look to the centre for training.

10. NUMBER OF EMPLOYEES VERSUS USE OF CENTRE

The following data implies that firms with fewer than 200 employees will find a computer applications centre most useful for consulting advice, plastic moulding assistance, and both part and mould design drawings:

APPLICATION	TOTAL		200 or Less		Over 200	
	N	%	N	%	N	%
TOTAL	112	100	92	82	20	18
Consulting Advice	68	61	63	68	12	60
Training	47	42	43	47	4	20
Materials Selection	22	20	18	20	4	20
Cost Estimating	29	26	25	27	4	20
Plastic Moulding	68	58	51	55	14	70
Part Design-Drawing	60	54	46	50	14	70
Mould Design-Drawing	52	46	45	49	7	35
Mould Machining	24	21	21	23	3	15
Tape Preparation	24	21	22	24	2	10
DB or CP-Walk-in	19	9	8	9	2	10
DB or CP-Own Access	20	18	17	19	3	15

It should be noted that the limited sample size makes the data for firms with over 200 employees statistically unreliable.

RESEARCH

SHERIDAN PARK RESEARCH COMMUNITY
MISSISSAUGA ONTARIO CANADA L5K 1B3 • (416) 822-4111 • TELEX 06-982311

Messieurs,

Afin de mieux vous servir, nous avons besoin d'information de votre part pour évaluer un projet de recherche et développement en cours à l'Institut de génie des matériaux. L'ORF (Ontario Research Foundation) effectue ce sondage sous l'auspice de l'Institut.

Le projet implique le développement de programmes pour l'Ingénierie Assistée par Ordinateur dans le domaine du moulage par injection des plastiques. Certains logiciels seraient disponibles pour aider à l'évaluation du matériel et l'analyse du débit, du remplissage et du refroidissement.

Ils pourraient aider à localiser les seuils et lignes de soudure, dimensionner et équilibrer les canaux d'alimentation, maximiser le nombre de cavités par moule et minimiser les temps des cycles. Egalement, le logiciel soutiendrait le design et l'analyse de résistance des pièces en plastique et des moules sous différentes conditions de fabrication et d'utilisation.

Les capacités de l'ordinateur à simuler la pièce définitive et son procédé de production, permet des changements avant l'usinage. Il peut réduire les coûts, permettre une livraison plus rapide, et faciliter la production de pièces de qualité supérieure. Potentiellement, les programmes pourraient être installés directement à votre système d'ordinateur ou le travail pourrait être fait à un centre de services.

Même si vous ne pouvez répondre qu'à quelques questions, nous apprécierions votre coopération.

Vos réponses individuelles ou celles données par quiconque désigné pour répondre aux questionnaire, seront confidentielles.

Le questionnaire est en anglais pour permettre aux réponses provenant du Canada entier d'être analysées et compilées ensemble.

Votre tout dévoué,

Paul C. Di Novo, M.B.A., P.Eng.
Services administratifs et industriels

:dr

Exhibit 1

RESEARCH

SHERIDAN PARK RESEARCH COMMUNITY
MISSISSAUGA ONTARIO CANADA L5K 1B3 • (416) 822-4111 • TELEX 06-982311

Gentlemen:

In order to serve you better, some information from you is needed to evaluate a Research and Development project currently proceeding at the Industrial Materials Research Institute. The Ontario Research Foundation is conducting this survey on their behalf.

The project involves development of programs for computer aided engineering in the area of plastic injection moulding. Some would be available to assist in material evaluation and analysis of flow, filling and cooling. They would help in locating gates and weld lines, sizing and balancing runner systems, maximizing the number of cavities per mould and minimizing cycle times. In addition, the software would support the design and stress analysis of plastic parts and moulds under different manufacturing and service conditions.

The ability of the computer to simulate the final part and its production process, allows changes to be made economically before tooling is made. It can lower costs, allow faster delivery, and facilitate the production of higher quality parts. Potentially, the programs could be installed on your own computer system or the work could be done at a service centre.

If you can only answer a few questions, we would still appreciate receiving your response. The individual answers provided by you, or whomever you designate to handle this questionnaire, will be kept confidential.

Yours truly,

Paul C. Di Novo, M.B.A., P.Eng.,
Industrial & Management Services

QUESTIONNAIRE

For each question with multiple choice answers, please circle the number corresponding to your answer.

1. In which Province is your firm or the division that may be interested in this subject located? (Please circle one only):

ONTARIO 1 QUEBEC 2 BRITISH COLUMBIA 3 OTHER 4 C1

2. How many people are employed by your company? (Please circle one only):

Less than 50 1 50-100 2 100-200 3 Over 200 4 C2

3. In what areas is your firm active? (Please circle all that apply):

Supply plastic resin material	1	C3
Injection mould plastic parts	2	C4
Manufacture moulds and dies for plastics	3	C5
Design plastic parts	4	C6
Design moulds for plastics	5	C7
None of the above	6	C8

3. Does your firm presently use its own computer, or is it planning to buy or lease one in the near future for any of the following applications? (Please circle all that apply):

Business (Accounting, Sales, Manufacturing, etc)	1	C9
Computer-Aided Drafting and Design	2	C10
Computer-Aided or Numerical Control Machining	3	C11
Plastic moulding (flow, thermal, stress or strain) simulation	4	C12
Other applications (please specify)_____	5	C13
Do not plan to use a computer in the near future	6	C14
Make and model of largest accessible computer_____		C39

5. If a centre offering assistance in other than business applications was established in your area, would you consider using it for any of the following? (Please circle all that apply):

Consulting advice	1	C15
Training	2	C16
Material selection	3	C17
Cost estimating	4	C18
Plastic moulding (flow, thermal, stress, or strain) simulation	5	C19
Part design - drawings	6	C20

Mould design - drawings	7	C21
Mould machining	8	C22
Prepare tapes to drive own numerically controlled machines	9	C23
Data base access or computer processing time only		
- (walk-in use)	10	C24
- (own terminal access)	11	C25
None of the above	12	C26

6. The Industrial Materials Research Institute believes that the capability to use computer-aided design for moulds will become essential for Canadian firms to be internationally competitive. Do you agree? (Please circle one only):

YES 1 NO 2 NO OPINION 3 C27

7. This question is on Moulding Simulation Software. Have you used any of the following programs? (Please circle all that apply):

CADMOULD	1	C28
MOLDFLOW	2	C29
OPTIMOLD	3	C30
MOLD COOL	4	C31
TMC (TOTAL MOULDING CONCEPT)	5	C32
MOLDFILL	6	C33
POLYCOOL	7	C34
OTHER (Please specify)_____	8	C35
NONE OF THE ABOVE	9	C36

8. Please identify your degree of satisfaction with any of the programs listed in 7 that you have used or are familiar with:

Very Good 1 Good 2 Average 3 Unsatisfactory 4 C37

9. Please provide any additional comments or information: _____

_____

_____

_____

_____

_____

Thank you. Please fold, staple and return to Ontario Research Foundation. The address is on the back. Thank you again.

SUMMARY OF RESPONSES TO EACH QUESTION

PROVINCE

C1	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	2	.	.	.
ONTARIO	91	91	71.094	71.094
QUEBEC	23	114	17.969	89.063
BRITISH COLUMBIA	4	118	3.125	92.188
OTHER	10	128	7.813	100.000

PEOPLE EMPLOYED BY COMPANY

C2	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	1	.	.	.
LESS THAN 50	67	67	51.938	51.938
50-100	25	92	19.380	71.318
100-200	13	105	10.078	81.395
OVER 200	24	129	18.605	100.000

SUPPLY PLASTIC RESIN MATERIAL

C3	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	128	128	98.462	98.462
RESPONSE	2	130	1.538	100.000

INJECTION MOULD PLASTIC PARTS

C4	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	42	42	32.308	32.308
RESPONSE	88	130	67.692	100.000

INJECTION MOULDS AND DIES FOR PLASTICS

C5	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	72	72	55.385	55.385
RESPONSE	58	130	44.615	100.000

DESIGN PLASTIC PARTS

C6	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	80	80	61.538	61.538
RESPONSE	50	130	38.462	100.000

DESIGN MOULDS FOR PLASTICS

C7	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	73	73	56.154	56.154
RESPONSE	57	130	43.846	100.000

SUMMARY OF RESPONSES TO EACH QUESTION

NONE OF ABOVE

C8	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	120	120	92.308	92.308
RESPONSE	10	130	7.692	100.000

BUSINESS

C9	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	29	29	22.308	22.308
RESPONSE	101	130	77.692	100.000

COMPUTER-AIDED DRAFTING AND DESIGN

C10	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	99	99	76.154	76.154
RESPONSE	31	130	23.846	100.000

COMP-AIDED/NUMERICAL CONTROL MACHINING

C11	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	102	102	78.462	78.462
RESPONSE	28	130	21.538	100.000

PLASTIC MOULDING

C12	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	112	112	86.154	86.154
RESPONSE	18	130	13.846	100.000

OTHER APPLICATIONS

C13	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	118	118	90.769	90.769
RESPONSE	12	130	9.231	100.000

DON'T PLAN USE COMPUTER IN NEAR FUTURE

C14	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	114	114	87.692	87.692
RESPONSE	16	130	12.308	100.000

SUMMARY OF RESPONSES TO EACH QUESTION

MAKE/MODEL LARGEST ACCESSIBLE COMPUTER

C39	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NONE	94	94	72.308	72.308
AGM3	1	95	0.769	73.077
ALPHA6240	1	96	0.769	73.846
APPLE MAC	1	97	0.769	74.615
COMMODORE64	1	98	0.769	75.385
COMPUTER VISION	1	99	0.769	76.154
HONEYWELL DPS8	1	100	0.769	76.923
HONEYWELL ULTIMA	1	101	0.769	77.692
HONEYWELL 6	2	103	1.538	79.231
HP 64K	1	104	0.769	80.000
HP9830A	1	105	0.769	80.769
IBM	2	107	1.538	82.308
IBM-PC	1	108	0.769	83.077
IBM-36	1	109	0.769	83.846
IBMPC	1	110	0.769	84.615
IBMPC XT	2	112	1.538	86.154
IBM32	1	113	0.769	86.923
IBM34	4	117	3.077	90.000
IBM36	1	118	0.769	90.769
IBM38	2	120	1.538	92.308
M3A3	1	121	0.769	93.077
PDP 11/44	1	122	0.769	93.846
PRIME9950	1	123	0.769	94.615
TRS MODEL 4	2	125	1.538	96.154
TRS80	1	126	0.769	96.923
VAX11-780	1	127	0.769	97.692
VICTOR9000	1	128	0.769	98.462
WANG	2	130	1.538	100.000

CONSULTING ADVICE

C15	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	62	62	47.692	47.692
RESPONSE	68	130	52.308	100.000

TRAINING

C16	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	83	83	63.846	63.846
RESPONSE	47	130	36.154	100.000

MATERIAL SELECTION

C17	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	108	108	83.077	83.077
RESPONSE	22	130	16.923	100.000

SUMMARY OF RESPONSES TO EACH QUESTION

COST ESTIMATING

C18	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	101	101	77.692	77.692
RESPONSE	29	130	22.308	100.000

PLASTIC MOULDING - SIMULATION

C19	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	65	65	50.000	50.000
RESPONSE	65	130	50.000	100.000

PART DESIGN - DRAWINGS

C20	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	70	70	53.846	53.846
RESPONSE	60	130	46.154	100.000

MOULD DESIGN - DRAWINGS

C21	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	78	78	60.000	60.000
RESPONSE	52	130	40.000	100.000

MOULD MACHINING

C22	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	106	106	81.538	81.538
RESPONSE	24	130	18.462	100.000

PREPARE TAPES TO DRIVE OWN NC MACHINES

C23	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	106	106	81.538	81.538
RESPONSE	24	130	18.462	100.000

DB OR CP - (WALK-IN USE)

C24	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	120	120	92.308	92.308
RESPONSE	10	130	7.692	100.000

DB OR CP - (OWN TERMINAL ACCESS)

C25	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	110	110	84.615	84.615
RESPONSE	20	130	15.385	100.000

ONTARIO RESEARCH FOUNDATION.

SUMMARY OF RESPONSES TO EACH QUESTION

NONE OF THE ABOVE

C26	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	112	112	86.154	86.154
RESPONSE	18	130	13.846	100.000

AGREE CAD FOR MOULDS ESSENTIAL

C27	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	10	.	.	.
YES	98	98	81.667	81.667
NO	6	104	5.000	86.667
NO OPINION	16	120	13.333	100.000

CADMOULD

C28	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	124	124	95.385	95.385
RESPONSE	6	130	4.615	100.000

MOLDFLOW

C29	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	114	114	87.692	87.692
RESPONSE	16	130	12.308	100.000

OPTIMOLD

C30	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	127	127	97.692	97.692
RESPONSE	3	130	2.308	100.000

MOLD COOL

C31	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	121	121	93.077	93.077
RESPONSE	9	130	6.923	100.000

TOTAL MOLDING CONCEPT

C32	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	126	126	96.923	96.923
RESPONSE	4	130	3.077	100.000

ONTARIO RESEARCH FOUNDATION.

SUMMARY OF RESPONSES TO EACH QUESTION

		MOLDFILL		
C33	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	126	126	96.923	96.923
RESPONSE	4	130	3.077	100.000

		POLYCOOL		
C34	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	126	126	96.923	96.923
RESPONSE	4	130	3.077	100.000

		OTHER		
C35	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	129	129	99.231	99.231
RESPONSE	1	130	0.769	100.000

		NONE OF THE ABOVE		
C36	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	32	32	24.615	24.615
RESPONSE	97	129	74.615	99.231
9	1	130	0.769	100.000

		SATISFACTION WITH PROGRAMS		
C37	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
NO RESPONSE	109	.	.	.
VERY GOOD	5	5	23.810	23.810
GOOD	9	14	42.857	66.667
AVERAGE	7	21	33.333	100.000

ONTARIO RESEARCH FOUNDATION.

PROVINCE VS. USE OF CENTRE

	PROVINCE									
	ALL		NO RESPONSE		ONTARIO		QUEBEC		BRITISH COLUMBIA	
	N	PCTN	N	PCTN	N	PCTN	N	PCTN	N	PCTN
--- TOTAL ---	130	100	2	2	91	70	23	18	4	3
CONSULTING ADVICE	68	100	1	1	50	74	12	18	2	3
TRAINING	47	100	0	0	35	74	8	17	2	4
MATERIAL SELECTION	22	100	0	0	16	73	2	9	1	5
COST ESTIMATING	29	100	0	0	19	66	7	24	1	3
PLASTIC MOULDING	65	100	1	2	42	65	13	20	4	6
PART DESIGN - DRAWINGS	60	100	1	2	39	65	10	17	3	5
MOULD DESIGN - DRAWINGS	52	100	0	0	36	69	9	17	2	4
MOULD MACHINING	24	100	0	0	17	71	2	8	4	17
PREPARE TAPES TO DRIVE OWN NC MACHINES	24	100	0	0	17	71	6	25	1	4
DB OR CP - (WALK-IN USE)	10	100	0	0	8	80	1	10	0	0
DB OR CP - (OWN TERMINAL ACCESS)	20	100	0	0	15	75	2	10	1	5
NONE OF THE ABOVE	18	100	1	6	13	72	2	11	0	0

ONTARIO RESEARCH FOUNDATION.

PROVINCE VS. USE OF CENTRE

	PROVINCE OTHER	
	N	PCTN
---- TOTAL ----	10	8
CONSULTING ADVICE	3	4
TRAINING	2	4
MATERIAL SELECTION	3	14
COST ESTIMATING	2	7
PLASTIC MOULDING	5	8
PART DESIGN - DRAWINGS	7	12
MOULD DESIGN - DRAWINGS	5	10
MOULD MACHINING	1	4
PREPARE TAPES TO DRIVE OWN NC MACHINES	0	0
DB OR CP - (WALK-IN USE)	1	10
DB OR CP - (OWN TERMINAL ACCESS)	2	10
NONE OF THE ABOVE	2	11

ONTARIO RESEARCH FOUNDATION.

NUMBER OF EMPLOYEES VS. USE OF CENTRE

	PEOPLE EMPLOYED BY COMPANY									
	ALL		NO RESPONSE		LESS THAN 50		50-100		100-200	
	N	PCTN	N	PCTN	N	PCTN	N	PCTN	N	PCTN
---- TOTAL ----	130	100	1	1	67	52	25	19	13	10
CONSULTING ADVICE	68	100	0	0	29	43	15	22	12	18
TRAINING	47	100	0	0	20	43	13	28	10	21
MATERIAL SELECTION	22	100	0	0	10	45	3	14	5	23
COST ESTIMATING	29	100	0	0	14	48	7	24	4	14
PLASTIC MOULDING	65	100	0	0	30	46	12	18	9	14
PART DESIGN - DRAWINGS	60	100	0	0	28	47	9	15	9	15
MOULD DESIGN - DRAWINGS	52	100	0	0	25	48	14	27	6	12
MOULD MACHINING	24	100	0	0	9	38	7	29	5	21
PREPARE TAPES TO DRIVE OWN NC MACHINES	24	100	0	0	9	38	9	38	4	17
DB OR CP - (WALK-IN USE)	10	100	0	0	5	50	2	20	1	10
DB OR CP - (OWN TERMINAL ACCESS)	20	100	0	0	7	35	4	20	6	30
NONE OF THE ABOVE	18	100	1	6	11	61	2	11	0	0

ONTARIO RESEARCH FOUNDATION.

NUMBER OF EMPLOYEES VS. USE OF CENTRE

	PEOPLE EMPLOYED BY COMPANY OVER 200	
	N	PCTN
---- TOTAL ----	24	18
CONSULTING ADVICE	12	18
TRAINING	4	9
MATERIAL SELECTION	4	18
COST ESTIMATING	4	14
PLASTIC MOULDING	14	22
PART DESIGN - DRAWINGS	14	23
MOULD DESIGN - DRAWINGS	7	13
MOULD MACHINING	3	13
PREPARE TAPES TO DRIVE OWN NC MACHINES	2	8
DD OR CP - (WALK-IN USE)	2	20
DD OR CP - (OWN TERMINAL ACCESS)	3	15
NONE OF THE ABOVE	4	22

ONTARIO RESEARCH FOUNDATION.

TYPE OF PROGRAM VS. SATISFACTION LEVEL

			SATISFACTION WITH PROGRAMS									
	ALL		NO RESPONSE		VERY GOOD		GOOD		AVERAGE			
	N	PCTN	N	PCTN	N	PCTN	N	PCTN	N	PCTN		
TOTAL	130	100	109	84	5	4	9	7	7	5		
CADMOULD	6	100	0	0	2	33	2	33	2	33		
MOLDFLOW	16	100	1	6	2	13	7	44	6	38		
OPTIMOLD	3	100	0	0	0	0	2	67	1	33		
MOLD COOL	9	100	1	11	2	22	3	33	3	33		
TOTAL MOLDING CONCEPT	4	100	0	0	1	25	2	50	1	25		
MOLDFILL	4	100	1	25	0	0	2	50	1	25		
POLYCOOL	4	100	1	25	0	0	2	50	1	25		
OTHER	1	100	0	0	0	0	1	100	0	0		
NONE OF THE ABOVE	98	100	97	99	0	0	0	0	1	1		

ONTARIO RESEARCH FOUNDATION.

TYPE OF PROGRAM VS. NUMBER OF EMPLOYEES

	PEOPLE EMPLOYED BY COMPANY									
	ALL		NO RESPONSE		LESS THAN 50		50-100		100-200	
	N	PCTN	N	PCTN	N	PCTN	N	PCTN	N	PCTN
TOTAL	130	100	1	1	67	52	25	19	13	10
CANMOULD	6	100	0	0	1	17	2	33	0	0
MOLDFLON	16	100	0	0	7	44	5	31	2	13
OPTIMOLD	3	100	0	0	1	33	1	33	0	0
MOLD COOL	9	100	0	0	4	44	3	33	1	11
TOTAL MOLDING CONCEPT	4	100	0	0	1	25	2	50	0	0
MOLDFILL	4	100	0	0	1	25	1	25	1	25
POLYCOOL	4	100	0	0	2	50	1	25	0	0
OTHER	1	100	0	0	0	0	1	100	0	0
NONE OF THE ABOVE	98	100	1	1	54	55	19	19	9	9

TYPE OF PROGRAM VS. NUMBER OF EMPLOYEES

	PEOPLE EMPLOYED BY COMPANY OVER 200	
	N	PCTN
---- TOTAL ----	24	18
CADMOULD	3	50
MOLDFLON	2	13
OPTIMOLD	1	33
MOLD COOL	1	11
TOTAL MOLDING CONCEPT	1	25
MOLDFILL	1	25
POLYCOOL	1	25
OTHER	0	0
NONE OF THE ABOVE	15	15

COMPUTER USE VS. NUMBER OF EMPLOYEES

	PEOPLE EMPLOYED BY COMPANY									
	ALL		NO RESPONSE		LESS THAN 50		50-100		100-200	
	N	PCTN	N	PCTN	N	PCTN	N	PCTN	N	PCTN
— TOTAL —	130	100	1	1	67	52	25	19	13	10
BUSINESS	101	100	0	0	45	45	23	23	11	11
COMPUTER-AIDED DRAFTING AND DESIGN	31	100	0	0	13	42	7	23	4	13
COMP-AIDED/NUMERICAL CONTROL MACHINING	28	100	0	0	15	54	7	25	4	14
PLASTIC MOULDING	18	100	0	0	8	44	2	11	4	22
OTHER APPLICATIONS	12	100	1	8	3	25	2	17	2	17
DON'T PLAN USE COMPUTER IN NEAR FUTURE	16	100	1	6	12	75	2	13	1	6

COMPUTER USE VS. NUMBER OF EMPLOYEES

	PEOPLE EMPLOYED BY COMPANY OVER 200	
	N	PCTN
---- TOTAL ----	24	18
BUSINESS	22	22
COMPUTER-AIDED DRAFTING AND DESIGN	7	23
COMP-AIDED/NUMERICAL CONTROL MACHINING	2	7
PLASTIC MOULDING	4	22
OTHER APPLICATIONS	4	33
DON'T PLAN USE COMPUTER IN NEAR FUTURE	0	0

EXHIBIT 4 - LIST OF COMPANIES RESPONDING

MAIL QUESTIONNAIRES

COMPANY	PROVINCE
Akromold (Goderich) Ltd.	Ontario
Allied Plastics	Ontario
Alpha Plastics Limited	Quebec
Alvo Industries Ltd.	Ontario
Amptech Corporation	Alberta
Anchor Cap & Closure Corp.	Ontario
Arris Design and Development	Ontario
Arrow Tool Die Mould Making	Ontario
Austin, Carl & Co. Ltd.	Ontario
B & D Plastic Ltd.	Saskatchewan
Benlan Inc.	Ontario
Bouteilles Browns (Canada)	Quebec
Bow Plastiques Ltee.	Quebec
Bradley-Fenn Enterprises-Plax	Ontario
Butler Polymet	Ontario
Canada Table Pak Inc.	Ontario
Canadian Coleman Co. Ltd.	Ontario
Canadian Feed Screws Mfg. Ltd.	Ontario
Canadian General Electric Co.	Ontario
Canron Inc.-Div. Plastiques	Quebec
Capilano Plastics Co. Ltd.	B.C.
Cavalier Tool & Mfg. Ltd.	Ontario
Chester Plastics (1975) Ltd.	Nova Scotia
Coleco Canada	Quebec
Columbia Plastics Limited	B.C.
Commercial Marine Limited	Ontario
Comptec International Ltd.	B.C.
Continental Heel Ltd.	Ontario
Copak (Montreal) Ltee.	Quebec
Courval Tooling Inc.	Quebec
Custom Nameplates Ltd.	Ontario
D B M Reflex Enterprises Inc.	Quebec
Davidson Rubber Co. Ltd.	Ontario

COMPANY	PROVINCE
Delhi Die & Manufacturing Co.	Ontario
Dennis Mould Design/Cadem Technology	Ontario
Diemaster Tool Inc.	Ontario
Die-Mold Tool Limited	Ontario
Dominion Moulds	Ontario
Dow Chemical Canada Inc.	Ontario
Duramould Limited	Ontario
Edmundston Paper Box Ltd.	New Brunswick
Ekco Canada Inc.	Ontario
Embalex Limited	Ontario
Emu Plastics Ltd.	Ontario
Endre Tool & Mold Company Ltd.	Ontario
Erin Interactive Designs Inc.	Ontario
Exacu Mould Inc.	Ontario
F & T (FAT) Tooling Inc.	Ontario
Fastex Division Plastiglide Limited	Ontario
Firan - Glendale Corp.	Ontario
Geo. Cluthe Mfg. Co. Ltd.	Ontario
H.E. Vannatter Limited	Ontario
Hara Products Ltd.	Saskatchewan
Hergott Plastics Ltd.	Ontario
Horizon Plastics Ltd.	Ontario
I-T-E Industries Inc.	Quebec
Ideal Mold Corporation Limited	Ontario
Industrial Moulds Limited	Ontario
Izon Industries Inc.	Ontario
J. & P. Coats (Canada) Inc.	Quebec
Kaufman Footwear Inc. Ltd.	Ontario
Kord Products Ltd.	Ontario
Lakeside Plastics Limited	Ontario
Lamko Tool & Mold Inc.	Ontario
Lamoureux & Fils Inc.	Quebec
Injection Uni-Cavite Inc.	Quebec

COMPANY	PROVINCE
Lindsay Specialty Products Ltd.	Ontario
Lukian Plastic Closures Ltd.	Ontario
Lustro-Plus Inc.	Ontario
MBE Plastics Ltd.	Alberta
Machine-O-Matic Ltd.	Ontario
Mavana Associates Limited	Ontario
Metric Mold (1983) Inc.	Ontario
Michel Dallaire Designers Inc.	Quebec
Mitchell Plastics Limited	Ontario
Moules et Matrices Precision	Quebec
Norseman Plastics Ltd.	Ontario
Olsonite Company Ltd.	Ontario
Outillages K & K Ltee.	Quebec
Pano Cap Limited	Ontario
Peerless-Cascade Plastics Ltd.	Ontario
Permalite Industries Ltd.	Ontario
Plastex Industries Ltd.	Quebec
Plastibo Inc.	Quebec
Plastique D.C.N. Inc.	Quebec
Plastiques Gagnon Inc.	Quebec
Plastomer Incorporated	Ontario
Polytainers Ltd.	Ontario
Preciform Inc.	Quebec
Precimold Inc.	Quebec
Primex Mfg. Ltd.	B.C.
Progressive Tools Ltd.	Ontario
Promold	Ontario
Quality Containers Ltd.	Nova Scotia
Redoe Mold Co. Ltd.	Ontario
Reliance Products Ltd.	Manitoba
Reliance Products Limited	Ontario
Rene Fibre de Verre Ltee.	Quebec

COMPANY	PROVINCE
Rubbermaid Canada Inc.	Ontario
S & K Moulds Ltd.	Ontario
S. Huot (1976) Inc.	Quebec
Sagesser Plastique Corp.	Quebec
Samsonite (Beatrice Int'l)	Ontario
Scepter Mfg. Co. Ltd.	Ontario
Schwartz Chemical of Can Ltd.	Ontario
Six Points Plastics Inc.	Ontario
Smith & Stone (1982) Ltd.	Ontario
Somerville Belkin Industries	Ontario
Sigma Moulders Inc.	Ontario
Societe Manufacturiere Ro-Ma	Quebec
Speers McGonigal (1980) Ltd.	Manitoba
Spencer-Lemaire Industries Ltd.	Alberta
Stahle Plastics Inc.	Ontario
Stamco Tool & Die Ltd.	Ontario
Staroba Plastic & Metal Prods	Ontario
Starplex Scientific	Ontario
T.L. Graham Associates Ltd.	Ontario
Tarxien Company Limited	Ontario
Techmire Ltee/Ltd.	Quebec
Teknor Plastics Inc.	Ontario
Terra Nova Shoes Ltd.	Newfoundland
Thermoset Plastics Inc.	Ontario
Tilco Plastics (1976) Ltd.	Ontario
Tiros Plastics Canada	Ontario
Tooling Enterprises	Ontario
Toronto Plastics Limited	Ontario
Triangle Plastics Ltd.	Ontario
Twinpak Inc.	Quebec
Unique Mould Makers Limited	Ontario
Uzin Industries Inc.	Quebec
Van Der Zwaag Molds & Dies Inc.	Ontario

COMPANY	PROVINCE
Waltec Engineering Ltd.	Ontario
Weber Manufacturing Limited	Ontario
Wirefab Industries	Ontario
Wood, W.C. Co. Ltd.	Ontario
X-Sy St Tool & Mold	Ontario
Zygo Mould & Parts Ltd.	Ontario

EXHIBIT 4 - LIST OF COMPANIES RESPONDING

INTERVIEWS

COMPANY NAME	PROVINCE
Canadian Institute of Metal Working	Ontario
Centre de Recherche Industrielle du Quebec	Quebec
Canadian Plastics Institute	Ontario
Society of the Plastics Industries of Canada	Ontario
Bayer Canada Inc.	Ontario
D. B. Business Systems Inc.	Ohio (U.S.)
Ontario Centre for Advanced Manufacturing	Ontario
Adamson Industrial Design Inc.	Ontario
Amflo Engineering Inc.	Ontario
Borg Warner (Canada) Ltd.	Ontario
Capilano Plastics Co. Ltd.	B.C.
Centennial College	Ontario
Du Pont of Canada Limited	Ontario
Erin Interactive Designs Inc.	Ontario
George Brown College	Ontario
Husky Injection Molding Systems Ltd.	Ontario
I.T.L. Industries Ltd.	Ontario
Dennis Mold Design Ltd.	Ontario
Magna International Inc. (Plastics)	Ontario
Mold Masters Ltd.	Ontario
PLAX, Division of Bradley-Fenn Enterprises Inc.	Ontario
Precimold Inc.	Quebec
Quality Plastics	Ontario
Ryka Blow Molds Ltd.	Ontario
Structural Dynamics Research Corporation	Ohio (U.S.)